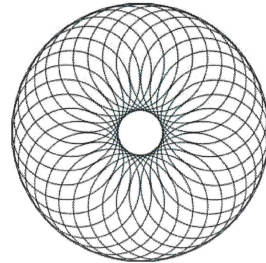


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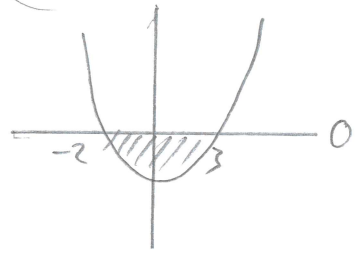
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<ul style="list-style-type: none"><li>(1) Indices</li><li>(2) Expanding Brackets</li><li>(3) Factorising Expressions</li><li>(4) More Indices (Negative and Fractional)</li><li>(5) Working with Surds</li><li>(6) Solving Quadratic Equations</li><li>(7) Completing the Square for Quadratics Expressions</li><li>(8) Function Notation</li><li>(9) Sketching Quadratic Graphs</li><li>(10) The Discriminant for Quadratic Equations</li><li>(11) Applications of Quadratics Equations</li><li>(12) Solving Linear Simultaneous Equations</li><li>(13) Linear &amp; Non-Linear Simultaneous Equations</li><li>(14) Graphing Simultaneous Equations</li><li>(15) Linear Inequalities</li><li>(16) Quadratic Inequalities</li><li>(17) Graphing Inequalities</li><li>(18) Shading Inequalities</li><li>(19) Cubic Graphs</li><li>(20) Quartic Graphs</li><li>(21) Reciprocal Graphs</li><li>(22) The Intersection of Graphs</li><li>(23) Transforming Graphs (Translations)</li><li>(24) Transforming Graphs (Stretching/Reflecting)</li><li>(25) Straight Line Graphs in the form <math>y = mx + c</math></li><li>(26) More Straight Line Graphs</li><li>(27) Straight Line Graphs (Parallel &amp; Perpendicular)</li><li>(28) The Geometry of Straight Lines</li><li>(29) The Application of Linear Graphs</li><li>(30) Circle Geometry Midpoint &amp; Perpendicular</li></ul>	<ul style="list-style-type: none"><li>(31) The Equation of a Circle</li><li>(32) Circles and Straight Lines (Intersections)</li><li>(33) Circles (Tangents and Chords)</li><li>(34) Circles and Triangles</li><li>(35) Algebraic Fractions</li><li>(36) Polynomial Division</li><li>(37) The Factor and Remainder Theorem</li><li>(38) An Introduction to Mathematical Proof</li><li>(39) Methods of Proof</li><li>(40) Binomial Expansion (Using Pascal's Triangle)</li><li>(41) Binomial Expansion (Factorial Notation)</li><li>(42) Binomial Expansion (The <math>\binom{n}{r}</math> Method)</li><li>(43) Binomial Expansion (Problem Solving)</li><li>(44) Binomial Expansion (Estimations and Approximations)</li><li>(45) The Cosine Rule</li><li>(46) The Sine Rule</li><li>(47) Areas of a Triangles</li><li>(48) Triangles (Problem Solving)</li><li>(49) Sine, Cosine &amp; Tangent Graphs</li><li>(50) Transforming Graphs (Trigonometry)</li><li>(51) The 'CAST' Diagram for Trig Ratios</li><li>(52) Trigonometry (Exact Values)</li><li>(53) Proving Trigonometric Identities</li><li>(54) Solving Basic Trigonometric Equations</li><li>(55) More Challenging Trigonometric Equations</li><li>(56) Using Identities to Solve Trig Equations</li><li>(57) Vectors (Introduction)</li></ul>	<ul style="list-style-type: none"><li>(58) Vector Notation (Column and i and j form)</li><li>(59) Vectors (Magnitude and Direction)</li><li>(60) Vectors (Position and Direction Vectors)</li><li>(61) Vector Geometry</li><li>(62) Application of Vectors</li><li>(63) Differentiation (Gradients of Curves)</li><li>(64) Differentiation from 1st Principles</li><li>(65) Differentiating <math>x^n</math> (Basic Powers of )</li><li>(66) Differentiation (Quadratic Expression)</li><li>(67) Differentiation (Multiple Terms)</li><li>(68) Differentiation (Gradients, Tangents and Normals)</li><li>(69) Differentiation (Increasing and Decreasing Functions)</li><li>(70) Differentiation (Stationary Points)</li><li>(71) Differentiation (Gradient Functions)</li><li>(72) The Applications of Differentiation</li><li>(73) Integration (Basic Expressions (<math>x^n</math>))</li><li>(74) Indefinite Integrals</li><li>(75) Integration (Finding <math>c</math> and Finding Functions)</li><li>(76) Integration (Definite Integrals)</li><li>(77) Integration (Basic Areas Under Curves)</li><li>(78) Integration ('Negative and Positive Areas')</li><li>(79) Integration (Areas between Curves and Lines)</li><li>(80) Basic Exponential Functions</li><li>(81) 'The' Exponential Function <math>y = e^x</math></li><li>(82) Applications of Basic Exponential Models</li><li>(83) Logarithms (Simplifying &amp; Evaluating)</li><li>(84) Logarithms (The Log Laws)</li><li>(85) Logarithms (Log and Exponential Equations)</li></ul>
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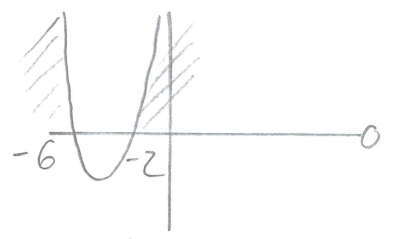
# 16 Quadratic Inequalities

①  $(x-3)(x+2) < 0$



$-2 < x < 3$

②  $(x+2)(x+6) \geq 0$



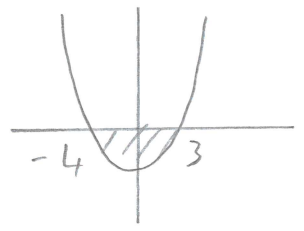
$x \leq -6$  or  $x \geq -2$

③  $x^2 \geq 4$   
 $x^2 - 4 \geq 0$   
 $(x+2)(x-2) \geq 0$



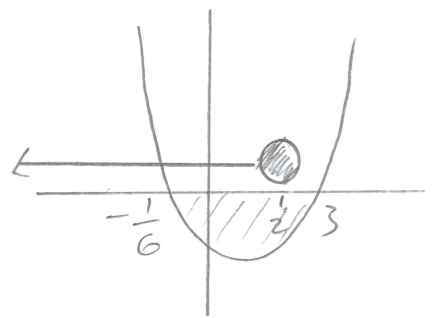
$x \leq -2$  or  $x \geq 2$

①  $-x^2 < 12+x$   
 $0 < x^2+x-12$   
 $(x+4)(x-3) < 0$



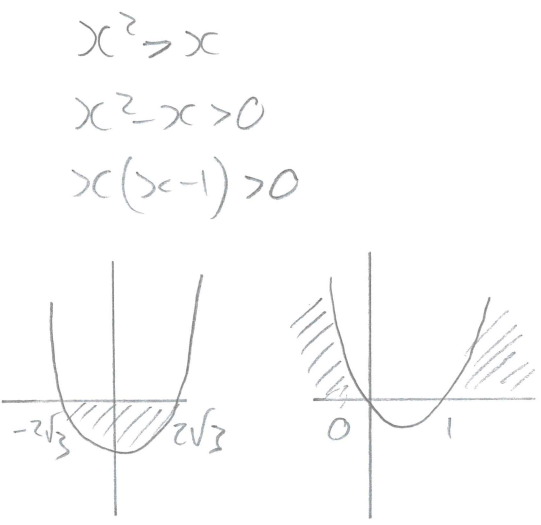
$-4 < x < 3$

②  $6x^2 - 17x - 3 \leq 0$   
 $(6x+1)(x-3) \leq 0$



$4 \geq 2x$   
 $2 \geq x$   
 $\therefore -\frac{1}{6} \leq x \leq 2$

③  $x^2 < 12$   
 $x^2 - 12 \leq 0$   
 $(x+2\sqrt{3})(x-2\sqrt{3}) \leq 0$



$\therefore -2\sqrt{3} \leq x \leq 2\sqrt{3}$  or  $1 < x \leq 2\sqrt{3}$

①  $6x^2 + x - 1 \leq 0$   
 $(2x+1)(3x-1) \leq 0$

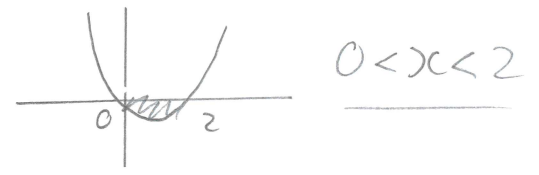


$x > \frac{k}{2}$

$\therefore \frac{k}{2} > \frac{1}{3}$  or  $\frac{k}{2} < -\frac{1}{2}$   
 $k > \frac{2}{3}$  or  $k < -1$

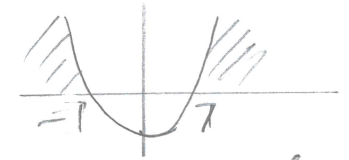
②  $\frac{4}{x} > 2$   $(x \neq 0)$

$4 > 2x$   
 $0 > 2x^2 - 4x$   
 $0 > 2x(x-2)$



$0 < x < 2$

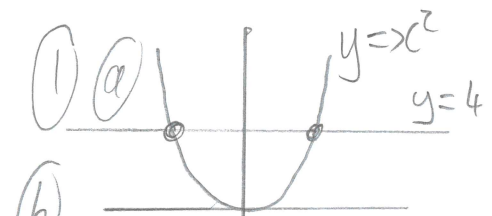
③  $8(x+1) \leq 1(x+1)^2$   
 $8x+8 \leq x^2+2x+1$   
 $0 \leq x^2-6x-7$   
 $0 \leq (x-7)(x+1)$



$\therefore -1 \leq x$  or  $x \geq 7$

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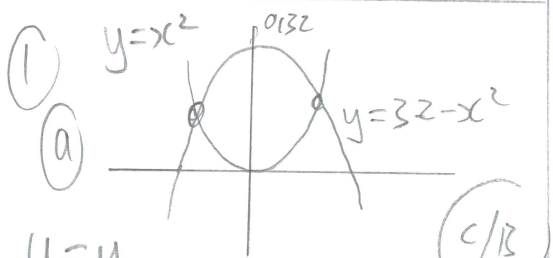
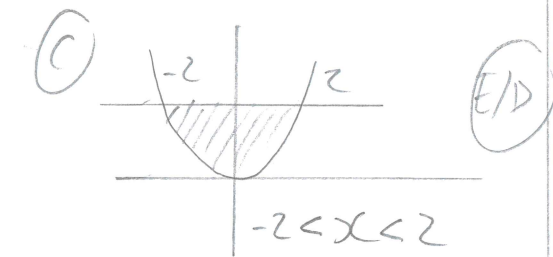
# 17 Inequalities on Graphs



b

$y = y$   
 $\therefore x^2 = 4$   
 $x = \pm 2$

$(-2, 4)$  and  $(2, 4)$

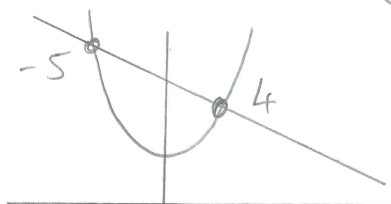
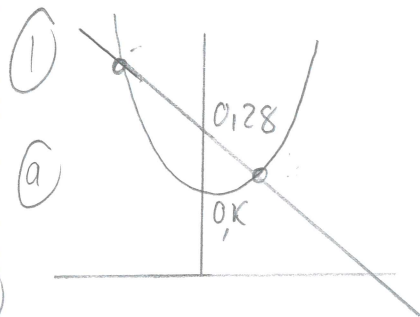
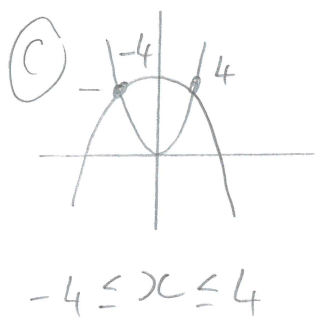


b

$y = y$   
 $\therefore x^2 = 32 - x^2$   
 $2x^2 = 32$   
 $x^2 = 16$   
 $x = \pm 4$

$\therefore (-4, 16)$  and  $(4, 16)$

(C/B)



Sub 4 into the linear.

$\therefore 28 - 4 = 24$

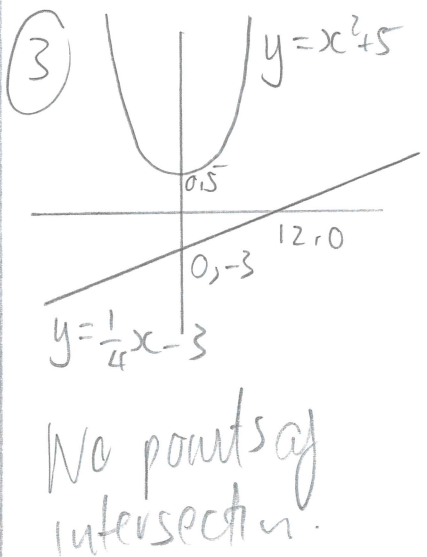
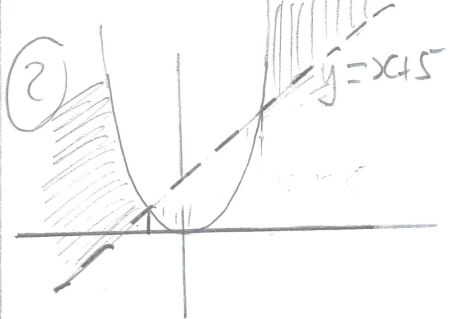
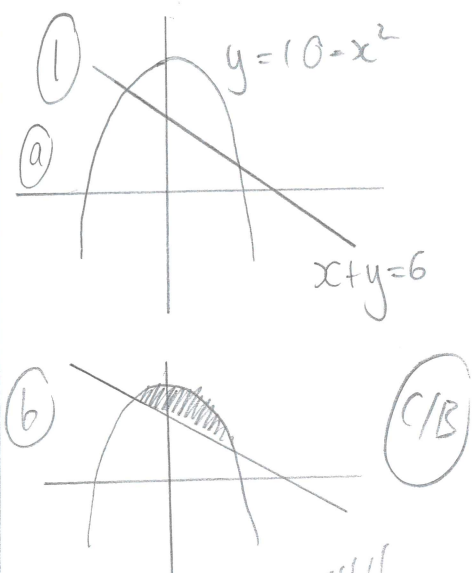
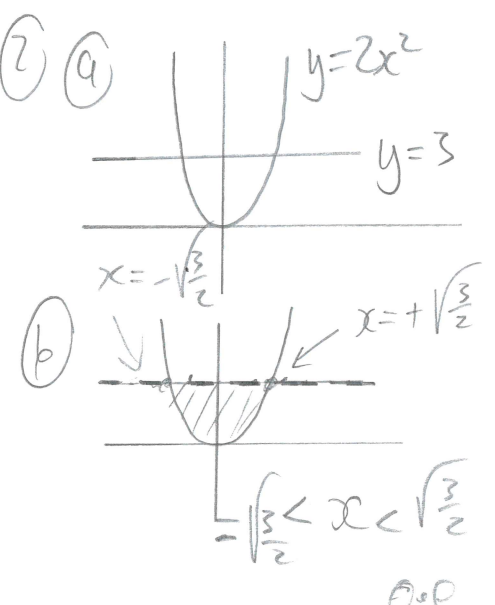
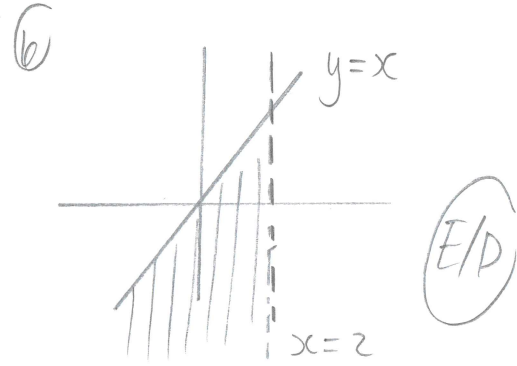
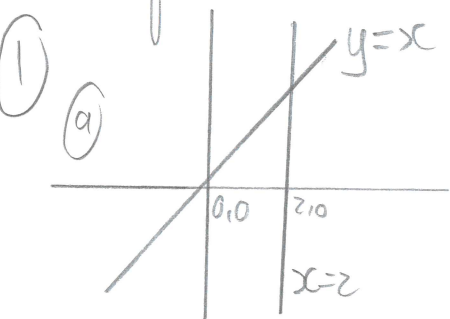
$(4, 24)$  must lie on  $y = x^2 + k$

$24 = 16 + k$

$k = 8$

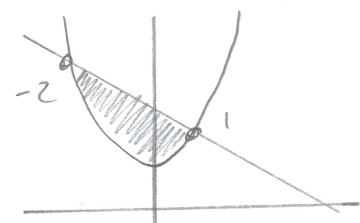
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# (18) Regions (Inequalities)



① a=4 ← Where the parabola cuts the y axis  
 (a) b=6 ← Where the line cuts the y axis.  
 (b)  $y = x^2 + 4$   
 $y = 6 - x$

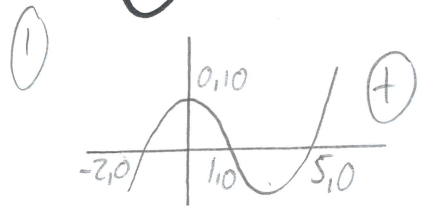
Set  $y = y$   
 $x^2 + 4 = 6 - x$   
 $x^2 + x - 2 = 0$   
 $(x+2)(x-1) = 0$   
 C.V:  $x = -2, x = 1$



Test the point (0,0)  
 if you want to check  
 $\therefore -2 \leq x \leq 1$

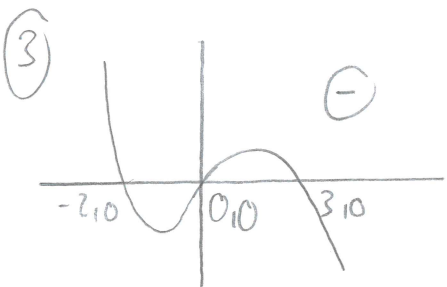
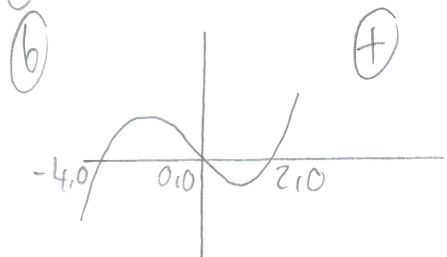
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# Pure (19) Cubic Graphs

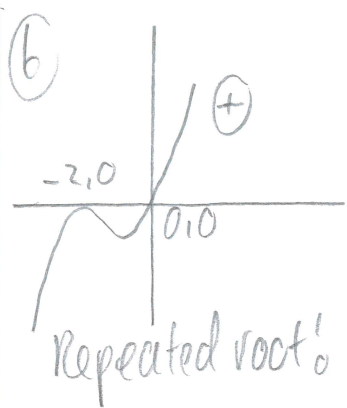


Crosses y axis when  $x=0$   
Crosses x axis when  $y=0$

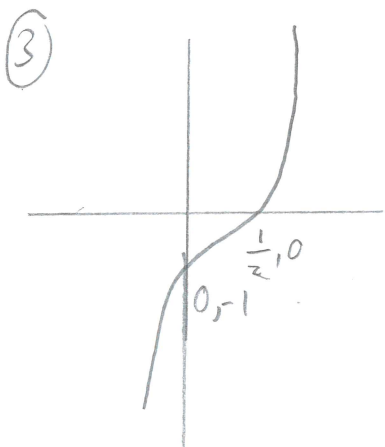
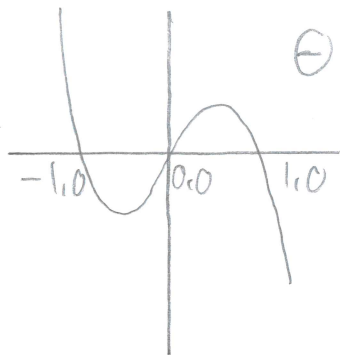
②  $x(x^2 + 2x - 8)$   
③  $x(x+4)(x-2)$



① ④  $x(x^2 + 4x + 4)$   
 $x(x+2)(x+2)$   
 $x(x+2)^2$



⑦  $y = -x(x^2 - 1)$   
 $= -x(x+1)(x-1)$



①  $y = 2x^3 + bx^2 + cx + d$   
Sub in values  
(-2, 0)  $0 = -16 + 4b - 2c + d$  ①  
(1, 0)  $0 = 2 + b + c + d$  ②  
(3, 0)  $0 = 54 + 9b + 3c + d$  ③  
3 unknowns, 3 equations

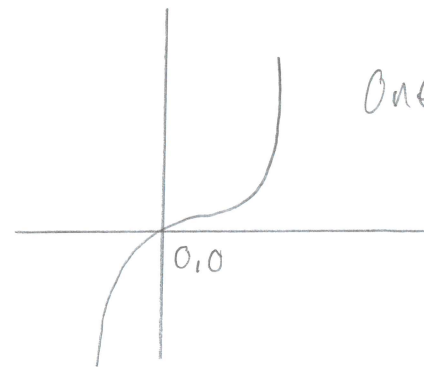
$16 = 4b - 2c + d$  ①  
 $-4 = 2b + 2c + 2d$  ②  
① + ②  $12 = 6b + 3d$

$-6 = 3b + 3c + 3d$  ②  
 $-54 = 9b + 3c + d$  ③  
② - ③  
 $48 = -6b + 2d$

$12 = 6b + 3d$   
 $48 = -6b + 2d$   
 $5d = 60$   
 $d = 12$   
 $\therefore b = -4$

Sub  $d = 12$  and  $b = -4$   
into ① ② or ③  
②  $0 = 2 - 4 + c + 12$   
 $c = -10$

②  $y = x(x^2 + a)$

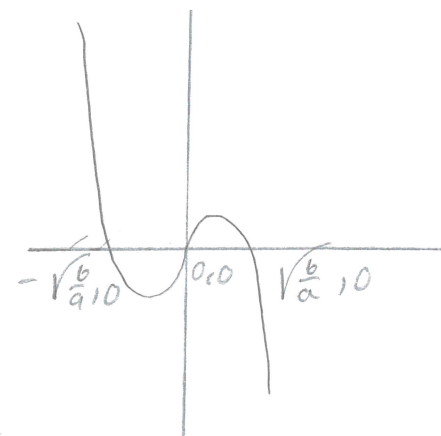


One real root as  
 $x^2 + a \neq 0$   
for real values of  $a$ ,  $a > 0$

③  $y = -ax^3 + bx$   
 $= -x(ax^2 - b)$

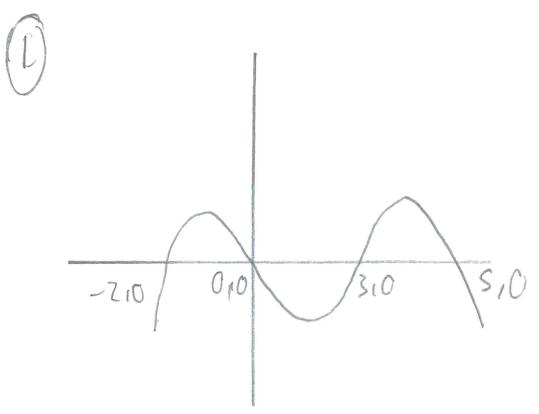
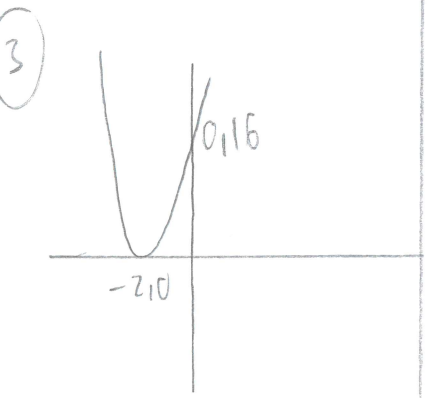
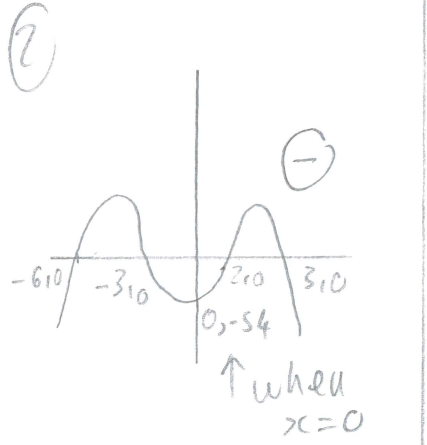
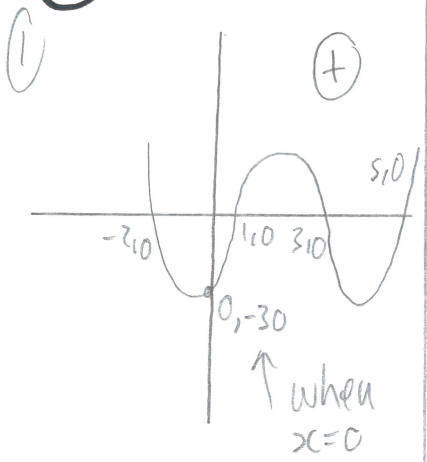
$\therefore x = 0$  or  $ax^2 - b = 0$

$x = \pm \sqrt{\frac{b}{a}}$  or  $\frac{\sqrt{ab}}{a}$



Negative cubic graph

# 20 Quadratic Graphs

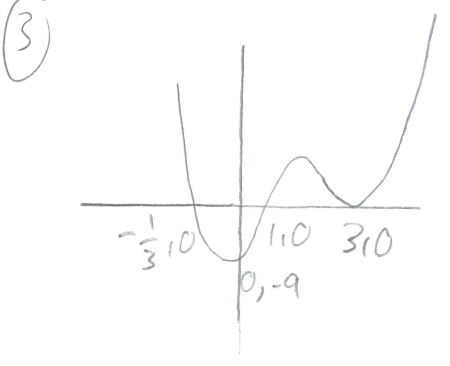
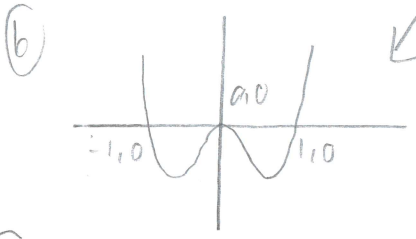


② a

$$x^4 - x^2$$

$$x^2(x^2 - 1)$$

$$x^2(x+1)(x-1)$$



①

$$y = x^2(x+1)(x-1)$$

$$= x^2(x^2 - 1)$$

$$= x^4 - x^2$$

$\therefore b=0, c=-1, d=0, e=0$

② Only has 2 roots, both positive  
 $\therefore y = (x-a)(x-b)(x^2+c)$   
 when  $a, b$  and  $c$  are real numbers  
 and all  $> 0$ .  
 eg  $y = (x-2)(x-5)(x^2+8)$  for example.

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